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P.O. Box 2443			SINGH, PREM C	
Bartlesville, OK 74005			ART UNIT	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/732,877	Applicant(s) JIANG ET AL.	
	Examiner Prem C. Singh	Art Unit 1764	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 March 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 13-49 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 13-49 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 10 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of claims 13-37 in the reply filed on 03/08/2007 is acknowledged.

Response to Amendment

2. Amendment to specifications is noted.
3. Amendment to claims 13, 14, 15, 23, 24, 26, 27, 31, 34, and 35, and addition of new claims 38-49 is noted.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

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1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claims 13-22, and 38-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hills (US Patent 4,269,791).

8. With respect to claims 13 and 14, Hills discloses a technique for providing a mixture of a plurality of gases. Hills discloses, "The invention employs a plurality of needle injectors which provide each gas to a column of liquid. The needle injectors are coupled to sources of the gases to be mixed, such as hydrogen and oxygen, and regulated so that the total volume of gas delivered to the injectors will be maintained at a specific ratio for controlling the end mixture. The column of liquid is then caused to have a turbulent flow at one portion to provide a mixing region for the gases. The

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gases in the turbulent region transfer through the liquid boundary between the bubbles in the column of liquid until equilibration occurs." (Column 2, lines 22-33). "The final gas concentration at the output of the mixing chamber may then be used to directly supply the correct ratio of gas mixture for use on site." (Column 2, lines 43-45).

Hills further discloses, "The diameter of the injectors can be controlled to produce any desirable diameter bubble" (Column 3, lines 31-33).

Although Hills does not specifically mention about the superficial velocity of gases, the invention does disclose the flow of hydrogen and oxygen in a specific ratio (See column 3, line 68; column 4, lines 1-2 and 33-37). Thus, it would have been obvious to one skilled in the art at the time the invention was made to calculate the superficial velocity simply by dividing the volumetric flow rate by the free cross sectional area of the cylindrical vessel. Also, one skilled in the art would optimize the process parameters including the superficial velocity in a range, including as that claimed, to get proper mixing of the two gases. See *In re Boesch*, 205 USPQ 215 (CCPA 1980).

Although Hills does not specifically mention about supplying the reactant gas mixture to a reaction zone, the invention does mention to supply the gas mixture for use on site, thus, it would have been obvious to one skilled in the art at the time the invention was made to modify Hills invention and take the mixture of gases to a reaction zone to produce products from the reactant gases.

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9. With respect to claim 15, Hills discloses a pump (14) (see figure) so that a continuous flow is provided throughout the enclosure (13) (see column 3, lines 13-14). Hills also discloses, "The column of liquid is then caused to have a turbulent flow at one portion to provide a mixing region for the gases." (Column 2, lines 29-31).

10. With respect to claim 16, Hills discloses use of hydrogen and oxygen in the invention. Although the invention does not specifically mention using a hydrocarbon gas, the invention does mention, "The device can be used to provide on-site mixtures of hydrogen-oxygen or any other gases for storage or on-site use that would normally exhibit explosive tendencies following mixing." (Column 5, lines 5-8). Since a mixture of oxygen and hydrocarbon gases is explosive similar to a mixture of oxygen and hydrogen, it would have been obvious to one skilled in the art at the time the invention was made to modify Hills invention and substitute hydrogen by a hydrocarbon gas and prepare a mixture of hydrocarbon gas and oxygen for downstream processing and avoid any explosion.

11. With respect to claims 17 and 18, Hills does not specifically mention oxygen to carbon molar ratio.

As discussed under claim 16, use of hydrocarbon gas would have been obvious to one skilled in the art. Knowing the hydrocarbon gas, the molar ratio of oxygen to carbon can be easily calculated.

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12. With respect to claim 19, Hills does not specifically mention the pressure in the tank.

The invention does mention using a turbulent condition in the liquid and mixing of two gases, thus the system must be under pressure. Therefore, it would have been obvious to one skilled in the art at the time the invention was made to modify Hills invention and specify the pressure in the tank for proper control of the turbulent conditions and mixing of two gases.

13. With respect to claim 20, Hills does not specifically mention the aspect ratio of the tank.

The invention discloses, "The length of the water column must be such as to allow substantially complete equilibration between bubbles to occur over the distance traveled by the bubbles prior to their withdrawal." (Column 3, lines 49-52). Thus, it would have been obvious to one skilled in the art at the time the invention was made to modify Hills invention and use a proper height-to-diameter ratio (i.e., aspect ratio) of the column, including the claimed range of 1-15, to achieve complete equilibrium between bubbles.

14. With respect to claim 21, Hills discloses, "The mixture is then withdrawn from the system at exit port (18) where it may be used to continuously supply gas for other purposes as may be required." (Column 3, lines 46-49).

Although, Hills does not specifically mention heating the reactant gas mixture, it would have been obvious to one skilled in the art at the time the invention was made to modify Hills invention and use heated gas mixture where needed, and thus produce different reaction products from the hydrocarbon gas and oxygen.

15. With respect to claim 22, Hills discloses, "In operation, the pump (14) provides the turbulent flow of liquid, in this case water, to the base of the enclosure (13)."

(Column 3, lines 23-25).

16. With respect to claim 38, Hills does not specifically mention about the velocity of reactant gas.

As mentioned earlier under claims 13 and 14, it would have been obvious to one skilled in the art at the time the invention was made to specify the velocity of reactant gas going to the reactor to control the reaction.

17. With respect to claim 39, Hills does not specifically mention about external gas recirculation.

Since Hills is using two gases (hydrogen and oxygen, for example) to make a mixture, some gases are bound to be escaping without properly mixing. Thus, it would have been obvious to one skilled in the art at the time the invention was made to re-circulate the individual gases for proper mixing.

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18. With respect to claim 40, Hills uses liquid circulation from the bottom of the tank (13) to the top of the tank and therefrom through conduit (15) back to the bottom.

19. With respect to claim 41, Hills discloses using a pump (14) which inherently comprise an impeller.

20. With respect to claim 42, Hills discloses vertical baffles (16) and horizontal baffles (17) (See Figure).

21. With respect to claim 43, Hills does not specifically mention using methane. However, as discussed under claim 16, it would have been obvious to one skilled in the art at the time the invention was made to replace hydrogen with a hydrocarbon gas (including methane) and carry out mixing between methane and oxygen as disclosed by Hills.

22. With respect to claim 44, Hills does not specifically mention using an organic liquid.

Since Hills is producing a mixture of hydrogen and oxygen using a liquid, in this case water, (See claim 22), it would have been obvious to one skilled in the art at the time the invention was made to modify Hills invention and substitute water with any other liquid, including the organic liquids as claimed, because one skilled in the art would use water for hydrogen-oxygen mixture and an organic liquid for hydrocarbon gas-oxygen mixture.

23. Claims 23-37 and 45-49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hills (US Patent 4,269,791) in view of Hershkowitz et al (US Patent 5,883,138).

24. Claim 23 has all the limitations of claim 13, and in addition, requires supplying at least a portion of the reactant gas mixture to a reactor, and reacting at least a portion of the hydrocarbon gas with oxygen to form a reaction product.

Hills does not specifically mention using a reactor.

Hershkowitz invention uses an injector/reactor apparatus and efficient process for partial oxidation of light hydrocarbon gases. Hershkowitz discloses, "The process involves providing pressurized, preheated sources of a light hydrocarbon gas such as methane and oxygen and injecting said individual gases at high velocity through injector manifold." (Column 4, lines 42-49). Hershkowitz further discloses that methane and oxygen react in a catalytic reactor producing synthesis gas (see column 4, lines 56-67; column 5, lines 1-5).

It is to be noted that Hershkowitz uses a similar arrangement for mixing methane and oxygen as that used by Hills, with the only difference that Hershkowitz setup does not contain a liquid column for mixing methane and oxygen. Use of a liquid column is necessary to allow substantial equilibrium between bubbles, and also the liquid will be continuously recycled by the pump (14) to maintain the turbulent flow as is required to provide the desired mixing (see Hills, column 3, lines 49-55). Thus, it would have been

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obvious to one skilled in the art at the time the invention was made to modify Hills invention, substitute hydrogen with methane, take the mixture of methane and oxygen from Hills setup and react in the partial oxidation reactor of Hershkowitz setup to produce synthesis gas.

25. Claims 24 and 25 have all the limitations of claims 14,16, and 23 and discussed before.

26. Claim 26 has all the limitations of claims 15,16, and 23, and already discussed before.

27. Claim 27 has all the limitations of claims 16,19, and 23, and already discussed before.

28. Claim 28 has all the limitations of claims 20 and 23, and already discussed before.

29. Claims 29 and 30 have all the limitations of claims 17,18, and 23.

Hills does not disclose O₂-to-carbon molar ratio.

Hershkowitz discloses O₂-to-carbon molar ratio from 0.3 up to 0.8 to 1 mole of (C). (see column 4, lines 51-52).

As discussed under claim 23, it would have been obvious to one skilled in the art at the time the invention was made to modify Hills invention and use methane or any light hydrocarbon gas with an appropriate O₂-to-carbon molar ratio, including in the claimed range, for a proper mixture of hydrocarbon gas and oxygen to make synthesis gas.

30. With respect to claim 31, Hills does not disclose heating the reactant gas mixture.

Hershkowitz discloses using a preheated mixture of oxygen and methane gas (see column 5, lines 20-22).

Since preheating the mixture of hydrocarbon gas and oxygen will increase the reaction rate in the partial oxidation reactor, it would have been obvious to one skilled in the art at the time the invention was made to modify Hills invention and use methane in place of hydrogen, preheat the mixture and then take to the partial oxidation reactor to produce synthesis gas.

31. With respect to claims 32 and 33, Hills does not disclose using hydrocarbon liquids.

The invention discloses, "In operation, pump (14) provides the turbulent flow of liquid, in this case water." (Column 3, lines 23-24). This means that the liquid may be other than water. Thus, it would have been obvious to one skilled in the art at the time the invention was made to modify Hills invention and use a hydrocarbon liquid instead of water. Since hydrogen has been replaced by a hydrocarbon gas (as discussed

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under claims 16 and 23), a hydrocarbon liquid is available on-site as a result of reaction between the hydrocarbon gas and oxygen producing synthesis gas, which is subsequently converted to methanol and methanol-based products (see Hershkowitz, column 13, lines 42-47) and therefore, the hydrocarbon liquid can be used in the tank avoiding use of water which has to be obtained from outside sources.

32. With respect to claims 34 and 35, Hills does not disclose partial oxidation reactor and catalyst.

Hershkowitz discloses, "A process for the catalytic partial oxidation of light hydrocarbon gases such as methane to synthesis gas for subsequent hydrocarbon synthesis." (Column 4, lines 39-42).

Since Hills uses hydrogen and oxygen, but suggests that any gas can be used, it would have been obvious to one skilled in the art at the time the invention was made to modify Hills invention and substitute methane for hydrogen and take the mixture to the partial oxidation reactor as disclosed by Hershkowitz to produce synthesis gas.

33. Claim 36 has all the limitations of claim 23, and additionally, requires the gas mixture to contain a portion of liquid.

As disclosed by Hershkowitz, the mixture of methane and oxygen is going to the partial oxidation reactor at a velocity between 25 and 1000 ft/sec (see column 4, lines 61-62), some liquid is bound to be entrained with the gaseous mixture at such a high velocity. Thus, it would have been obvious to one skilled in the art at the time the

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invention was made to modify Hills invention and take the gaseous mixture entrained with the liquid to the partial oxidation step as disclosed by Hershkowitz to produce synthesis gas.

34. With respect to claims 37, Hills does not disclose producing C₅+ hydrocarbons.

Hershkowitz discloses, "The treated synthesis gas may be used to produce methanol and methanol-based products, hydrocarbon synthesis products such as liquid hydrocarbons, olefins, alcohols and aldehydes, oxo-synthesis products, ammonia and ammonia-based fertilizers and chemicals, etc." Column 13, lines 42-46).

As discussed under claim 23, it would have been obvious to one skilled in the art at the time the invention was made to modify Hills invention and take methane and oxygen in Hills setup, produce a mixture of gases, feed to the Hershkowitz setup of partial oxidation, produce synthesis gas, and subsequently, produce different hydrocarbon products, including C₅+ hydrocarbons, as disclosed by Hershkowitz to make an integrated process for producing methanol and other useful products starting with methane and oxygen.

35. With respect to claims 45 and 46, Hills does not specifically mention a single vessel having liquid turbulent mixing region and the reaction zone.

Hills figure shows the mixture of gases (hydrogen and oxygen in the example) going out of the port (18).

As discussed under claim 23, it would have been obvious to one skilled in the art at the time the invention was made to modify Hills invention and take methane and oxygen in the system as disclosed by Hershkowitz, produce a mixture of methane and oxygen from port (18) and conduct reaction between the two gases in a reactor integrated with the Hills setup. This arrangement will be compact and easy to control the production of hydrocarbon products.

36. Claim 47 has all the limitations of claim 23 and discussed before.

37. Claims 48 and 49 have all the limitations of claim 37 and discussed before.

Response to Arguments

38. Applicant's arguments filed 03/08/2007 have been fully considered but they are not persuasive.

Rejections under 103 (a) over Hills

39. The Applicant argues that in Hills' apparatus and method, the mixing of the gases primarily occurs through gas diffusion into the liquid phase and then diffusion from the liquid phase into the gas phase, and not through gas-to-gas transfer via bubble interactions by coalescence and breakage as in the present invention (see Specification

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[0016] on Page 4 as originally filed). Second, the turbulence of the liquid in Hills is achieved by a pump (see Hills Col. 3 lines 23-25), unlike the gas-induced turbulence effected by a high gas superficial velocity as in the present claimed invention of Claims 13-22. The bubble sizes described in Hills are in the range of 50 to 100 microns (see Hills Col. 3 lines 31-37), and Applicant believes that these very small-sized bubbles do not induce massive liquid turbulence, since a pump for liquid recirculation is required in Hills' system to provide sufficient liquid turbulence.

The Applicant's argument is not persuasive because Hills provides a technique for mixing gases using a plurality of small bubbles (See column 2, lines 8-9). Hills clearly mentions the reason for bubbling the gas in the liquid, "Since any explosion could only occur when bubbles directly collide with one another, the volume of gas subject to explosion would be small and would be contained in the minute chambers formed by the liquid walls surrounding the bubbles." (Column 2, lines 38-43). Hills further adds, "Even the mixture of such microbubbles by direct collision with others, rather than by equilibration through solution, will not result in any significant explosive problems since the technique will limit the explosive region to the bubble volume surrounded by its own liquid boundary." (Column 4, lines 14-19).

Hills is using a pump for the same purpose as the Applicant's claim 15.

40. The Applicant argues that with respect to the gas superficial velocity limitation of original Claim 14 now inserted into claim 13, the Examiner acknowledged that Hills does not mention the superficial velocity of gases. The Examiner though states in paragraph

7 on Page 5 of the Office Action that the disclosure by Hills of controlling the bubble diameter from the diameter of nozzles would lead one having ordinary skill in the art (at the time the invention was made) to an obvious variant of Hills' method by controlling the superficial gas velocity within the claimed range (5-60 cm/s) to produce the desirable bubble sizes as disclosed by Hills for proper mixing within the tank. The Applicant further argues that Hills fails to disclose critical information such as gas flow rates and cross-sectional area of the tank which are necessary to estimate the gas superficial velocity. Thus, Applicant submits that Hills' disclosure of desirable bubble sizes in the range of from 50 to 100 microns for H₂-O₂ gases injected in water (see Hills Col. 3 lines 31-37) is not sufficient for an artisan to determine that the superficial velocity of the gases is necessarily in the range of 5-60 cm/sec to achieve these bubble sizes. The superficial velocity of the gases may be well below 5 cm/sec to achieve these bubble sizes.

The Applicant's argument is not persuasive because Hills is supplying hydrogen and oxygen in a specific ratio (in this case, 95:5 percent hydrogen-oxygen) (See column 3, line 68; column 4, lines 1-2). Hills further adds, "The flow of hydrogen and oxygen to the needle injectors may be controlled such that the size of the bubbles in the most turbulent region will prevent significant explosions even for direct collision of pure hydrogen and oxygen bubbles." (Column 4, lines 33-37). This clearly indicates that the volumetric flow rates of hydrogen and oxygen are known. Hills is also disclosing a cylindrical enclosure (13) (See column 2, lines 66-67). Although Hills is not disclosing the diameter of the cylindrical enclosure, but it would have been obvious to one skilled

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in the art at the time the invention was made to modify Hills invention and measure the diameter of the enclosure and calculate the superficial velocity of gas(es). (Superficial velocity = Volumetric flow rate (cm^3/s) / open cross sectional area (cm^2)).

41. The Applicant argues (on the basis of Prince et al, AIChE JI, volume 36, No. 10, figure 6) that it can be inferred by the artisan from this teaching that Hills would use even smaller gas superficial velocity (i.e., less than 0.5 cm/sec) to achieve these very small-sized gas bubbles (0.05-0.1 cm) in this particular system. Because the mechanism for gas-to-liquid-to-gas mass transfer to effect $\text{H}_2\text{-O}_2$ mixing by equilibrium in Hills' method is indeed largely affected by the surface area of the bubbles/liquid boundary (i.e., small size bubbles), there would be no motivation in the artisan to increase the gas superficial velocity in the range (5-60 cm/sec) claimed in the present invention, as doing so would create larger bubble size and/or would further induce more bubble collisions, both of which are not intended nor desired by Hills.

The Applicant's argument is not persuasive because Hills discloses, "While the diameter of the injectors can be controlled to produce any desirable diameter bubble, for hydrogen and oxygen the bubbles will generally be maintained in a range of between 50 and 100 μm ." (Column 3, lines 31-35). Thus, when Hills teachings are modified to substitute a hydrocarbon gas for hydrogen (See Office action under claim 16), any specific size bubble could be created to achieve the desired superficial velocity.

42. The Applicant argues that as for the pressure of the mixing system, Applicant is unsure how a turbulent flow in the liquid would cause the system to be under pressure (as stated in paragraph 11 on Page 6 in the Office Action). A gas in a turbulent liquid does not necessarily cause the gas to be under pressure. Applicant respectfully requests the Examiner to further clarify this statement. If an artisan uses elevated pressure (as in the range claimed in Claim 19) in the mixing tank of Hills, the solubility of the gases (such as oxygen and hydrocarbon) in a liquid (such as water) would be expected to decrease; in which case the driving force of gas-to liquid mass transfer which is the first step of Hills' gas mixing method would also be reduced, thus providing a slower mass transfer rate from gas to liquid. Working at elevated pressure in the mixing tank of Hills thus would decrease the effectiveness of Hills' gas mixing method.

The Applicant's argument is not persuasive because Hills discloses, "The diffusivity of hydrogen in water for any particular pressure facilitates gas transfer for equilibrium at the required gas ratio and may be controlled by further modification of the turbulent conditions at the base of chamber (13)." (Column 4, lines 37-41).

Rejection under 103(a) over Hills in view of Hershkowitz

43. The Applicant argues that Hershkowitz's system and method of mixing further differs from Hills', in that the gases are injected at extremely high speeds into admixture with each other in the desired proportions, that is to say the mechanism for mixing in Hershkowitz's is by direct gas-to-gas mass transfer while achieving ca. 25 to 1000 ft/sec speed in the ejectors. Such speed is required by Hershkowitz to provide a dwell time of

the gas mixture within or immediately above the injector surface prior to passage into the reaction zone to less than about 5 milliseconds.

The Applicant's argument is not persuasive because the high velocity used by Hershkowitz is simply to mix the gases properly. Hershkowitz discloses, "As used herein, references to the velocity at which the gaseous premix is passed to the partial oxidation zone should be taken to mean the local gas velocity as the gaseous premix leaves the mixing nozzle, and not some reactor average superficial velocity." (Column 7, lines 13-17). Hills is also mixing the gases (hydrogen and oxygen) properly by passing through turbulent water column.

44. The Applicant argues that Hershkowitz does not remedy to Hills's failure to disclose a gas superficial velocity range as recited in the present claimed invention of Claims 23 and 37, and their respective dependent claims.

As discussed earlier, Hills does not specifically mention superficial velocity of gases, but because Hills is disclosing the ratio of gases, i.e., flow rates of gases, it would have been obvious to one skilled in the art to calculate the superficial velocity in the cylindrical column (13).

45. The Applicant argues that the substitution of Hershkowitz's gas mixing method for providing a reactant gas with the method of Hills as suggested by the Examiner to arrive to the present Claims 23-37 would not provide an effective gas delivery for the Hershkowitz's downstream partial oxidation zone. As explained in the above section,

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Hills's primary mechanism of gas mixing is via gas-to-liquid-to-gas mass transfer which can be achieved by a large surface area (bubble/water boundary), that is to say with very small-sized bubbles (50-100 microns), while avoiding excessive bubble collision. Because the mass transfer will be limited by the diffusivities of the gases into the liquid and because this additional resistance to mass transfer requires more time than gas-to-gas mass transfer, it seems unlikely that Hills's system will be able to deliver a mixed gas at a local gas velocity of ca. 25-1000 ft/sec to the close-proximity reaction zone of Hershkowitz's system. Moreover, a dwell time of the gas mixture within or immediately above the injector surface prior to passage into the reaction zone of less than 5 ms requires that the level of liquid from Hills' tank is very closely-spaced alignment with the face surface of the reaction zone, which would not provide Hills enough room to add the drying unit to eliminate water vapor from the gas mixture prior to use (see Hills Col. 4 lines 53-60).

The Applicant's argument is not persuasive because Hershkowitz reference has been used to add a downstream reactor to Hills setup (connected to port 18 in Hills figure) where the mixed gases (methane and oxygen) from Hills apparatus will be used to produce hydrocarbon products. Hershkowitz method of mixing the two gases is not needed in Hills. Hills's system does not need delivery of a mixed gas at a local gas velocity of ca. 25-1000 ft/sec. Hills needs gases (methane and oxygen) bubbled through storage vessels (10) and (11) and delivered through nozzles (12) in the cylindrical container (13) (See Hills Figure).

46. The Applicant argues that additionally, Hershkowitz's process is designed to be operated at elevated gas pressure. Thus, Hill's gas mixing method will need to operate at elevated pressure as well. However, as explained earlier, elevated pressure in the mixing tank of Hills is expected to decrease the solubility of the gases (such as oxygen and hydrocarbon gas) in a liquid (such as water), which would reduce the driving force of gas-to liquid mass transfer which is the first step of Hills' gas mixing method. Working at elevated pressure thus would decrease the efficacy of Hills' gas mixing method of Hills and would not be suitable for delivering a well-mixed gas reactant gas at close-to-sonic speed to the reaction zone of Hershkowitz.

The Applicant's argument is not persuasive because as mentioned before, Hershkowitz is mixing the two pressurized gases (methane and oxygen) at high velocity prior to oxidation reaction to avoid dangers normally presented by the explosive nature of a preheated mixture of oxygen and methane gas (See Hershkowitz: column 4, lines 38-67; column 5, lines 1-22). Hills on the other hand, is mixing the two gases by bubbling through a liquid column. Hills is not delivering a well-mixed reactant gas at close-to-sonic speed to the reaction zone of Hershkowitz. Hills is delivering the premixed gas through port (18) (See Hills Figure) to the reaction zone of Hershkowitz attached to port (18).

Conclusion

47. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Prem C. Singh whose telephone number is 571-272-6381. The examiner can normally be reached on MF 7:00 AM - 3:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn Caldarola can be reached on 571-272-1444. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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